I claim:

1. A method for fit testing a respirator having a breathing port, comprising the steps of:

a. placing the respirator on a test subject's face,

b. having the test subject hold his breath,

c. producing and maintaining a predetermined level of vacuum in the respirator; and

d. measuring a flow rate of air necessary to maintain said level of vacuum, wherein said steps of producing a vacuum in the respirator and measuring said flow rate of air are initiated simultaneously by the activation of a switch.

2. The method of claim 1, wherein the test subject inhales before holding his breath.

3. The method of claim 1, wherein the switch is activated by the test subject.

4. The method of claim 1, wherein the activation of the switch closes the breathing port of said respirator and a controlled negative pressure testing protocol initiates when intra-respirator pressure substantially equals ambient pressure.

5. The method of claim 4, wherein said step of producing and maintaining a predetermined level of vacuum in the respirator comprises monitoring internal respirator pressure to ensure that said pressure returns to an ambient pressure before the breathing port is closed.

6. The method of claim 1, wherein said step of producing and maintaining a predetermined level of vacuum in the respirator comprises closing the breathing port by generating an air pressure sufficient to move a diaphragm within the breathing port into an air-sealing position.

7. The method of claim 1, wherein said steps of producing and maintaining a predetermined level of vacuum in the respirator and measuring a flow rate of air necessary to maintain said level of vacuum comprise exhausting air from the respirator to generate and maintain a desired negative challenge pressure inside the respirator for a specified test period, whereby the challenge pressure is held constant, and measurement of a piston displacement rate yields a direct measure of an air leakage rate into the respirator.

8. The method of claim 1, wherein release of the switch results in the opening of the breathing port.

9. The method of claim 7, wherein internal respirator pressure is progressively reduced to the negative challenge pressure in order to limit challenge pressure overshoot.

10. The method of claim 9, wherein internal respirator pressure is progressively reduced to the negative challenge pressure by adjusting a motor control logic of a vacuum source based on the following iterative algorithm:

if in-mask pressure $\leq$ 25% of challenge pressure, set AFR = 3 x AFR and PLR = 3 x PLR; else

if in-mask pressure $\leq$ 50% of challenge pressure, set AFR = 2 x AFR and PLR = 2 x PLR; else

if in-mask pressure $\leq$ 75% of challenge pressure, set AFR = 1.5 x AFR and PLR = 1.5 x PLR; else

if in-mask pressure > 75% of challenge pressure, enter track phase of test, wherein AFR is attack flow rate and PLR is presumed mask leak rate.

11. The method of claim 7, wherein said internal respirator pressure is progressively stepped down to the negative challenge pressure by adjusting motor control logic of a vacuum source based on the following iterative algorithm:

if challenge pressure overshoot > 3 x challenge pressure, set AFR = AFR/3 and PLR = PLR/3; else

if challenge pressure overshoot > 2 x challenge pressure, set AFR = AFR/2 and PLR = PLR/2; else

if challenge pressure overshoot > 1.5 x challenge pressure, set AFR = AFR/1.5 and PLR = PLR/1.5; else

if challenge pressure overshoot > 1.25 x challenge pressure, set AFR = AFR/1.25 and PLR = PLR/1.25; else

proceed with fit test using current aggressive initial piston pull,

wherein AFR is attack flow rate and PLR is presumed mask leak rate.

12. The method of claim 7, wherein said measurement of a piston displacement rate further comprises:

a. storing pressure and leak flow rate information in an array during a track phase of the fit test; and

b. applying a post-test analysis algorithm to integrate all acceptable leak measurements while excluding those segments of the track phase that do not meet predetermined pressure criteria,

wherein an acceptable pressure bin is defined as a minimum portion of the track phase during which contiguous in-respirator pressure measurements all fall within a specified range of said challenge pressure.

13. The method of claim 7, wherein said measurement of a piston displacement rate further comprises:

a. identifying periods or bins of acceptable pressure tracking,

b. determining whether an acceptable number of such bins was produced during the fit test; and

c. integrating the flow rate measurements associated with each bin to determine the mean respirator leak rate for that specific test.

14. The method of claim 13, wherein test quality is quantified as a function of the number of acceptable pressure bins recorded during the fit test.

15. The method of claim 14, wherein said function comprises:

if bins > 3, then report measured leak rate; else

if 3 > bins > 0, then report estimated leak rate; else

if bins = 0, then report retry test.

16. The method of claim 12, wherein said specified range of said challenge pressure comprises ± 10%.

17. An apparatus for fit-testing a respirator, comprising:

a leak rate analyzer in closed gaseous communication with said respirator, wherein said leak rate analyzer comprises an air-pressure transducer operably connected to said respirator, a vacuum source responsive to said air-pressure transducer to maintain a predetermined vacuum level in the respirator; and an air-flow measuring device in gaseous communication with said respirator and said vacuum source, and wherein said vacuum source and said air-flow measuring device are simultaneously activated by a switch.

18. The apparatus of claim 17, wherein said air-flow measuring device and said vacuum source comprise a piston.

19. The apparatus of claim 18, wherein said piston is controlled by a stepper motor.

20. The apparatus of claim 18, wherein a by-pass orifice is present in tubing disposed between said piston and said leak rate analyzer.